4. Solvent Use

The use of solvents and other chemical products can result in emissions of various ozone precursors (i.e., ambient air pollutants).[1] Nonmethane volatile organic compounds (NMVOCs), commonly referred to as "hydrocarbons," are the primary gases emitted from most processes employing organic or petroleum based solvents. Surface coatings accounted for just under a majority of NMVOC emissions from solvent use—41 percent in 2001—while "non-industrial"[2] uses accounted for about 38 percent and degreasing applications for 7 percent. Overall, solvent use accounted for approximately 28 percent of total U.S. emissions of NMVOCs in 2001, and has decreased 13 percent since 1990.

Although NMVOCs are not considered direct greenhouse gases, their role as precursors to the formation of ozone—which is a greenhouse gas—results in their inclusion in a greenhouse gas inventory. Emissions from solvent use have been reported separately by the United States to be consistent with the inventory reporting guidelines recommended by the IPCC. These guidelines identify solvent use as one of the major source categories for which countries should report emissions. In the United States, emissions from solvents are primarily the result of solvent evaporation, whereby the lighter hydrocarbon molecules in the solvents escape into the atmosphere. The evaporation process varies depending on different solvent uses and solvent types. The major categories of solvent uses include: degreasing, graphic arts, surface coating, other industrial uses of solvents (i.e., electronics, etc.), dry cleaning, non-industrial uses (i.e., uses of paint thinner, etc.), and solvent utilization NEC. Because some of these industrial applications also employ thermal incineration as a control technology, combustion by-products (CO and NO_x) are also reported with this source category.

Total emissions of nitrogen oxides (NO_x), nonmethane volatile organic compounds (NMVOCs), and carbon monoxide (CO) from 1990 to 2001 are reported in Table 4-1.

Table 4-1: Emissions of NO_x, CO, and NMVOC from Solvent Use (Gg)

Activity	1990		1995	1996	1997	1998	1999	2000	2001
NO_x	**1**		**3**	**3**	**3**	**3**	**3**	**3**	**3**
Degreasing	+		+	+	+	+	+	+	+
Graphic Arts	+		1	1	1	1	+	+	+
Dry Cleaning	+		+	+	+	+	+	+	+
Surface Coating	1		2	2	2	2	3	3	3
Other Industrial Processes[a]	+		+	+	+	+	+	+	+
Non-Industrial Processes[b]	+		+	+	+	+	+	+	+
Other	NA		+	+	+	+	+	+	+
CO	**4**		**5**	**1**	**1**	**1**	**46**	**45**	**44**
Degreasing	+		+	+	+	+	+	+	+
Graphic Arts	+		+	+	+	+	+	+	+
Dry Cleaning	+		1	+	+	+	+	+	+
Surface Coating	+		1	1	1	1	46	45	44
Other Industrial Processes[a]	4		3	+	+	+	+	+	+
Non-Industrial Processes[b]	+		+	+	+	+	+	+	+
Other	NA		NA	+	+	+	+	+	+
NMVOCs	**5,217**		**5,609**	**4,969**	**5,100**	**4,671**	**4,533**	**4,422**	**4,584**

[1] Solvent usage in the United States also results in the emission of small amounts of hydrofluorocarbons (HFCs) and hydrofluoroethers (HFEs), which are included under Substitution of Ozone Depleting Substances in the Industrial Processes chapter.

[2] "Non-industrial" uses include cutback asphalt, pesticide application adhesives, consumer solvents, and other miscellaneous applications.

Degreasing	675		716	546	566	337	360	318	334
Graphic Arts	249		307	261	266	272	222	224	230
Dry Cleaning	195		209	140	148	151	265	268	274
Surface Coating	2,289		2,432	2,155	2,228	1,989	1,851	1,782	1,878
Other Industrial Processes[a]	85		87	96	100	101	94	99	104
Non-Industrial Processes[b]	1,724		1,858	1,768	1,790	1,818	1,701	1,690	1,721
Other	+		+	3	3	3	40	41	43

[a] Includes rubber and plastics manufacturing, and other miscellaneous applications.
[b] Includes cutback asphalt, pesticide application adhesives, consumer solvents, and other miscellaneous applications.
Note: Totals may not sum due to independent rounding.
+ Does not exceed 0.5 Gg.

Methodology

Emissions were calculated by aggregating solvent use data based on information relating to solvent uses from different applications such as degreasing, graphic arts, etc. Emission factors for each consumption category were then applied to the data to estimate emissions. For example, emissions from surface coatings were mostly due to solvent evaporation as the coatings solidify. By applying the appropriate solvent-specific emission factors to the amount of solvents used for surface coatings, an estimate of emissions was obtained. Emissions of CO and NO_x result primarily from thermal and catalytic incineration of solvent laden gas streams from painting booths, printing operations, and oven exhaust.

Data Sources

The emission estimates for this source were taken directly from EPA data published on the National Emission Inventory (NEI) Air Pollutant Emission Trends web site (EPA 2003). Emissions were calculated either for individual categories or for many categories combined, using basic activity data (e.g., the amount of solvent purchased) as an indicator of emissions. National activity data were collected for individual applications from various agencies.

Activity data were used in conjunction with emission factors, which together relate the quantity of emissions to the activity. Emission factors are generally available from the EPA's *Compilation of Air Pollutant Emission Factors, AP-42* (EPA 1997). The EPA currently derives the overall emission control efficiency of a source category from a variety of information sources, including published reports, the 1985 National Acid Precipitation and Assessment Program emissions inventory, and other EPA data bases.

Uncertainty

Uncertainties in these estimates are partly due to the accuracy of the emission factors used and the reliability of correlations between activity data and actual emissions.